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Mail Stop Provisional Patent Application

PTO/SB/16 (6-95)
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PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 CFR 1.53 (c).

	Docket Number	3638-177	Type a plus sign (+) inside this box→	+

INVENTOR(S)/APPLICANT(S)

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TITLE OF THE INVENTION (280 characters)

ATTACHMENT FOR A TELESCOPIC MATERIAL HANDLER THAT SUPPLIES FIVE ADDITIONAL DEGREES OF FREEDOM

CORRESPONDENCE ADDRESS

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification — Number of Pages: 7

☒ Drawing(s) — Number of Sheets: 12

☐ Applicant claims "small entity" status.
☐ "Small entity" statement attached.

☐ Other (specify)

METHOD OF PAYMENT *(check one)*

☒ A check or money order is enclosed to cover the Provisional filing fees ($160.00)/($80.00)

☒ The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140. A duplicate copy of this sheet is attached.

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The invention was made by an agency of the United States Government or under a contact with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,
SIGNATURE Alan M. Kagen

DATE March 30, 2004

TYPED or PRINTED NAME Alan M. Kagen

REGISTRATION NO. *(if appropriate)* 36,178

☐ Additional inventors are being named on separately numbered sheets attached hereto.

PROVISIONAL APPLICATION FILING ONLY

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STATE OF THE ART

The modern construction technologies utilize several types of materials delivered in form of long panels. Those have great advantages from aesthetic (less visible joints, high quality of finish), safety (high fire resistance) and economical (minimal number of construction steps, good insulation, air tight) points of view.
It seams that those highly engineered materials are requiring special equipment and processes to install them in safe, efficient way with minimal losses due to damage.

There are several patents and patents application (see results of Patent Search conducted on behalf of JLG Industries) and actual products intended to fulfill this need.
JLG is manufacturing EasyCladder and EasyCladder Plus attachments for the scissor lifts.

There are at least two manufacturers offering products for telescoping material handlers and vertical mast forklifts. Those attachments are briefly described below and illustrated in attachment A, Figures 1-9.

WIRTH ATTACHMENTS

One of the most successful producers of attachment for vertical cladding attachments is German company WIRTH GmbH selling attachments under trade name Oktopus®. The attachments are designed for work with different carriers- hanging from cranes, supported by forks of the forklift and designed to connect to the boom of the telescoping material handler.
Usually telescoping handler attachment have operator platform.

WIRTH attachments are fully self- contained. Vacuum pump, hydraulic system for lift and control system are powered by batteries build into their base.
Those attachments slip over forks of the telehandler (do not use Quick Switch or Quick Attach arrangement). It makes them easy to apply on different types of machines, however generates its own set of difficulties.

For horizontal panel installation Wirth attachment is equipped with pin-on section forming long platform. It allows operators to service complete length of joint area.

MERLO ATTACHMENTS

Italian telescoping handler manufacturer Merlo offers variety of cladding attachments for its machines. They use quick attachment change connection and are usually used with rotating models of Merlo telehandlers. Rotating machines have boom mounted on rotating upper structure (turntable), very similar to mobile cranes and excavators.
The latest model of this attachment was photographed in 2003.
This version has additional mechanisms for fine adjustment and positioning of the panel.

Product Claims

Summary

The JLG device is a telescopic telehandler (forklift) attachment that is to be used to pick, manipulate, transport and aid in the installation of both vertical and horizontal building panels (cladding). These tasks will be achieved through wireless control of the device's five degrees of freedom, the various degrees of freedom inherent with a normally operated telehandler, and the interaction of an additional operator(s) in an aerial work platform (AWP).

The device will be able to handle variety of cladding panels. Exemplary configuration of the panel are dimensions up to 1,3 x 8,0 meters in size and a mass of 350 kg. Panels are handled by means of an onboard vacuum system, which is described in further detail in the Pneumatic section below. The panel is manipulated and controlled as outlined in the Mechanical and Electrical and Control sections.

Mechanical System

Manipulation of the cladding panels consists of five powered degrees of freedom (DOF), and the hydraulic power for these motions is obtained from the telehandler auxiliary circuit. The structure and its motions are progressively described below from the telehandler attachment out to the vacuum cups. All of the device's degrees of freedom are exclusively controlled via the wireless system as described in the Electric and Control System section. The wireless controls can be seen in Figure 10 of Appendix A.

The first DOF allows for plus/minus rotation (for example +/-90°) of the entire device with respect to the telehandler boom. This motion can be seen below in Figure 11 and would be used to position the device's main arm normal (in the horizontal plane) to the cladding surface. The next DOF rotates the main arm of the device from horizontal to vertical, as seen in Figure 12, in accordance with the restrictions described in the Electric and Control System section. In this specific embodiment, this motion in effect allows for 900mm of horizontal and vertical (albeit interdependent due to the traversed arc) adjustment of the panel. The next DOF powers the four-bar mechanism that allows for rotation of the panel, for example 180° rotation, as seen in Figure 13, in order to un-nest the packaged panels. The panel flip range of

motion is also subject to the restrictions outlined in the Electric and Control System section. Figure 14 illustrates rotation (for example plus/minus 100 degrees) about the panel normal axis from the transport position of horizontal to provide for either horizontal or vertical cladding operations. The final degree of freedom provides panel translation (for example plus/minus 150mm) in the direction normal to the panel edge. This motion, as seen in Figure 15, seats the 'tongue and groove' seal that is incorporated on the cladding panels.

The structure of the device also includes a compartment with a lockable, hinged hood that houses the majority of the electronic, pneumatic and hydraulic components. The device also provides for some flexibility in its transport package size. The wings that support the outer two vacuum reservoirs[1] can be folded back to reduce the package width.

Pneumatic System

Pneumatic system includes vacuum pump, vacuum cups divided into independent circuits, each circuit with its own vacuum reservoir and blocking valve. In the exemplary embodiment twenty vacuum cups are divided into six independent circuits, four circuits with three vacuum cups and two circuits with four vacuum cups. There are three groups of vacuum cups; four circuits with three vacuum cups in a central cluster and two circuits with four vacuum cups to the right and left of the fore mentioned center cluster. Each group of vacuum cups is connected to a large tube that acts as a vacuum reservoir, storing vacuum in the event of a vacuum system failure. A normally closed valve ("manifold valve") separates each vacuum reservoir from the rest of the vacuum system. A vacuum pump, mounted in the compartment of this device, creates the vacuum in the system. Upon sufficient vacuum, the cladding panel can be manipulated into the appropriate mounting position and fastened to the building. Once the cladding panel is attached to the building the panel release valve is activated, thus releasing the vacuum from all circuits

The vacuum level in the system is measured using a vacuum switch. A green light will illuminate on the device when sufficient vacuum is achieved.

In the event of a failure in the vacuum system (as indicated by the vacuum switch) the green light will turn off and an alarm will sound. The manifold valves on each of the vacuum

[1] Refer to the Pneumatic section for more information.

reservoirs will close, preserving vacuum in each reservoir. This remaining vacuum will hold the panel for a period of time, so the operator can lower the panel into a safe position. A failure in the electrical system or vacuum pump will also cause these valves to close, holding the panel. Upon restart of the vacuum system, the reservoir side vacuum switch will check for vacuum and assume there is a panel if sufficient vacuum is present. For further details on the reservoir side vacuum switch see the electronic and control section.

Electrical & Control System

The electrical and control system allows radio remote control of the device, handles failures, stops the operator from moving into an unsafe orientation of the device, and increases the safety of the product.

The user will control the device with two battery powered radio transmitters, one blue and one yellow. The blue transmitter will be the primary, and the yellow transmitter will be the secondary. One or zero transmitters will have control of the device at any time. A pitch/catch system will be used to transfer control between transmitters. Each transmitter will have seven toggle switches, a proportional trigger, and an emergency stop (e-stop). The toggle switches will control the vacuum pump, transferring control, releasing the panel, and toggling between the five different motions. The proportional trigger will activate the selected function. The e-stop will turn the transmitter off. When the e-stop is pressed, the device will shutdown the movement functions, but the vacuum pump's status will not change.

The electrical and control system consists of two proximity sensors[2], two vacuum switches[3], and one radio receiver with a logic controller (PLC). The system controls the hydraulic block, the vacuum pump, the audible alarm, the manifold valves, the panel release valve, and the three lights[4]. The radio receiver controls the hydraulic block, with the exception of the two proximity sensor cutouts, which are controlled via relay logic. The radio receiver also controls the vacuum pump power relay, the panel release valve, the blue and yellow control lights. The receiver along with some relay logic, controls the audible alarm, which is enabled

[2] One each for panel lift and tilt.
[3] One switch is on the pump side of the vacuum system and the other is located on the panel side of the system, with the divisor being the vacuum reservoir valves.
[4] Each light is a different color. One light is blue, one is yellow, and one is green.

when the vacuum holding a panel is unexpectedly lost. Whenever the audible alarm is enabled, the manifold valves are disabled by relay control, causing them to close. (See the vacuum system section for more details.) The tilt up motion is limited by relay logic to prevent the panel from being tilted beyond 15 degrees from the vertical reference frame of the lift arm when the lift arm is raised above horizontal. The lift up motion is disabled by relay logic when the panel is tilted back over 15 degrees from the vertical reference frame of the lift arm. These cut outs are triggered by the previously mentioned proximity sensors. The pump side vacuum switch controls the green light, which is enabled when the system has reached the appropriate vacuum level.

The electrical power to the system is generated by either a hydraulic or gas powered generator. It is generated at 120VAC and is converted to 12VDC with a step down transformer and a rectifier. On the 12VDC circuit, there are three lights, six manifold valves, an audible alarm, four relays, ten hydraulic valves, four proximity switches, two vacuum switches, a proportional valve, and the radio controller. On the 120VAC circuit, there is the vacuum pump and the transformer.

The electrical and control system increases the safety of the device with proximity sensor cutouts, as described above, with the audible alarm and closing the manifold valves on a lost of vacuum, and with the lights to signal the status of the device. Without the cutouts, the device could break itself during normal operation. When the vacuum holding a panel is unexpectedly lost, the manifold valves close and use a small reservoir of vacuum to hold the panel in place for some time. This allows the panel to be safely lowered to the ground before the vacuum falls to an unsafe level. The blue light flashes when the blue transmitter is in control of the device. Likewise, the yellow light flashes when the yellow light is in control. Both lights will flash when neither is in control. The green light flashes when there is enough vacuum to safely maneuver the panel. The lights quickly show the operators who is in control of the system and if the panel is safe to move.

Future Art / Product Evolution & Adaptations

The current design is seen to have several adaptations and improvements. Using the flexible base design, various improvements in the current design will lead to better use in this application and uses in additional markets.

The primary design improvement being considered right now is a soft touch attachment for the suction cup array. This could include, but is not limited to, isolation and suspension components to protect the medium being handled by the device. A proposed layout for this type of component can be seen in Figure 16 of Appendix A. This component would allow for four inches of motion for the panel to reduce the likelihood of material damage during the installation process. This soft touch improvement would also allow the device to be used in the glass and stone fascia installation markets.

Another area for adaptation to specialized handling applications would be to create custom center sections and wing sections for any number of different materials and objects.

ABSTRACT

The proposed JLG device is an attachment for a telescopic material handler that supplies five additional degrees of freedom (DOF) for the task of picking, manipulating and aiding in the installation of vertical and horizontal wall cladding. The cladding can be of a size of up to 1,3 x 8,0 m and a mass of 350 kg. The control and positioning of this panel will be accomplished through the standard operation of the telehandler in conjunction with wireless control of the additional five DOF of the device. The hydraulic power for the device functions is supplied through the telehandler auxiliary circuit. The auxiliary flow also powers a hydraulic generator, which supplies the device with the required electrical power for both system logic & control and vacuum generation. The vacuum system is the means by which the cladding panels are handled by the device.

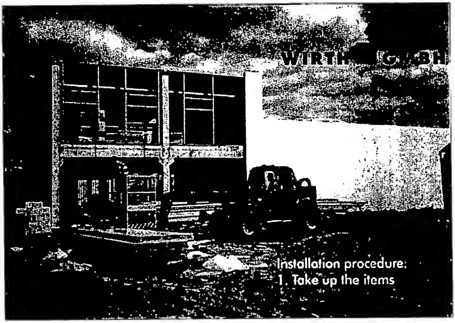

Figure 1. Step one for the Oktopus® vertical panel installation.

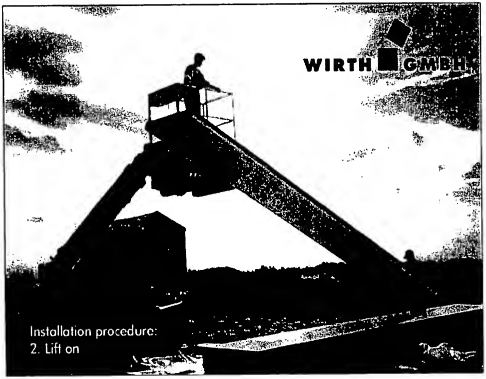

Figure 2. Step two for the Oktopus® vertical cladding device.

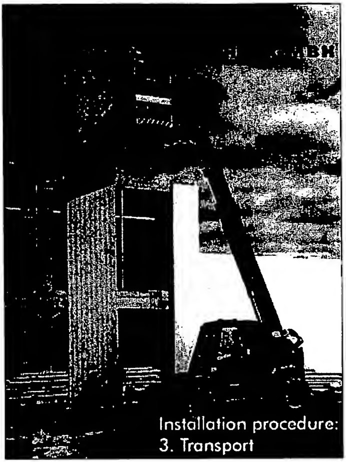

Figure 3. Oktopus® panel transportation.

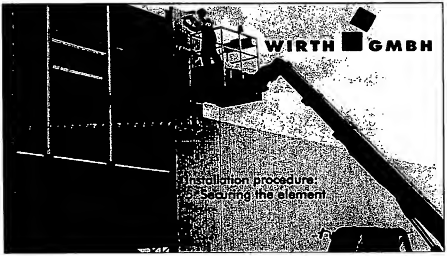

Figure 4. Panel adjustment and installation onto the building structure.

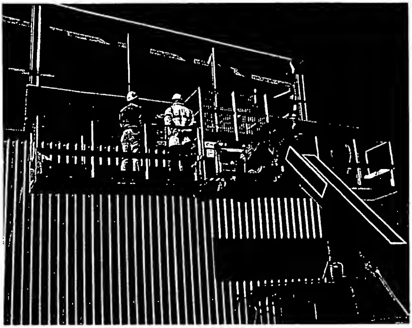

Figure.5. WIRTH Oktopus® horizontal panel attachment with long platform

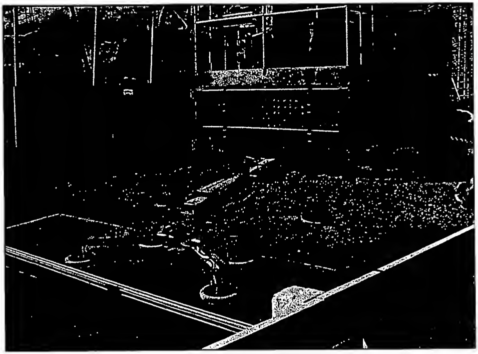

Figure 6. Merlo cladding attachment with arms adjusted for the installed panel size.

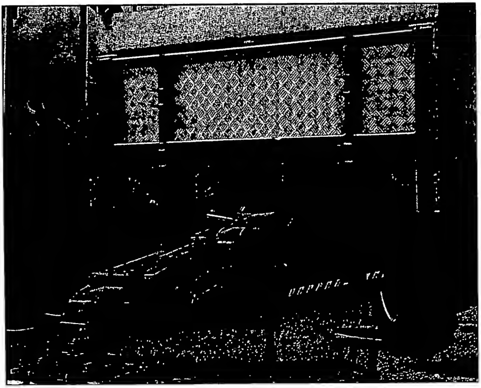

Figure 7. The gray members provide horizontal motion normal to the wall with the small cylinder adjacent to them providing the power.

Figure 8. Merlo device raised to the 'travel position' with the wall normal translation fully retracted as indicated by the arrow.

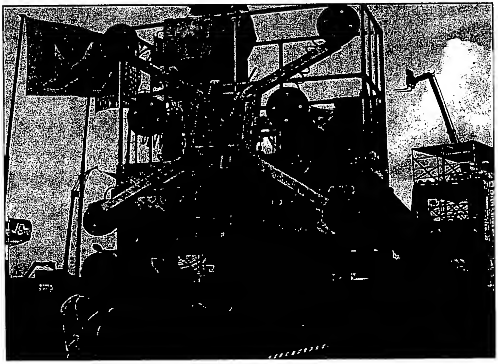

Figure 9. Merlo device raised to the travel position without a panel. It is unknown if the device rotates about the above indicated axis.

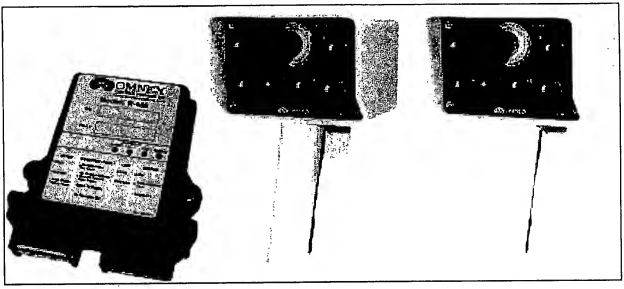

Figure 10.
Panel Remote Control.

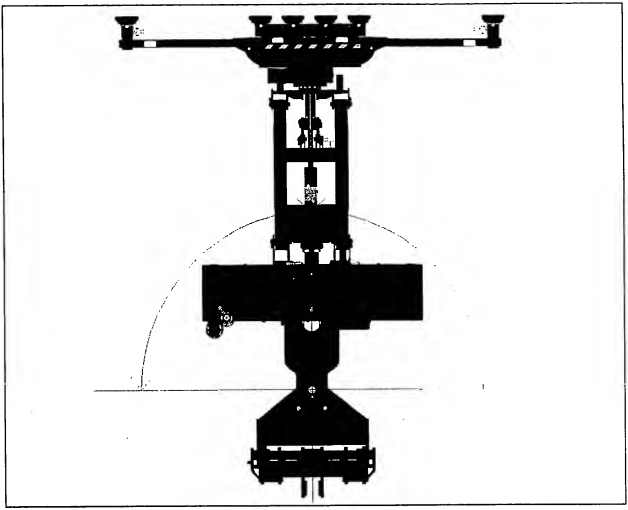

Figure 11.
Panel Swing.

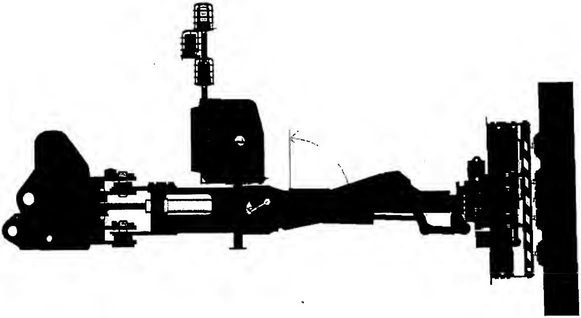

Figure 12.
Panel Lift.

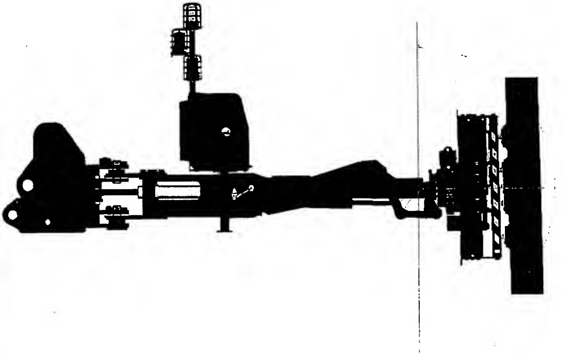

Figure 13.
Panel Tilt.

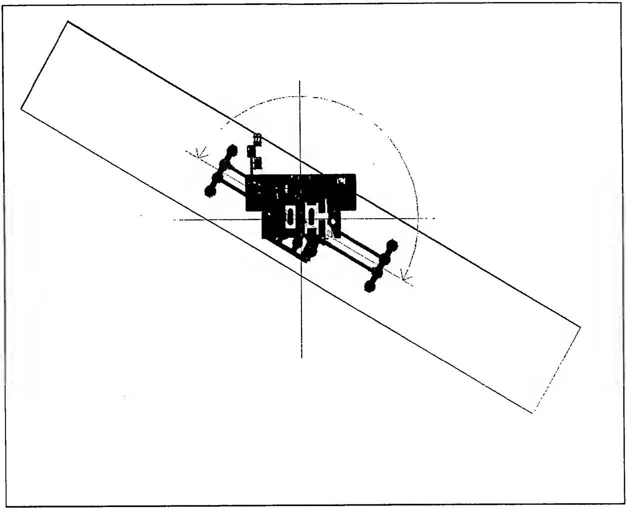

Figure 14.
Panel Rotate.

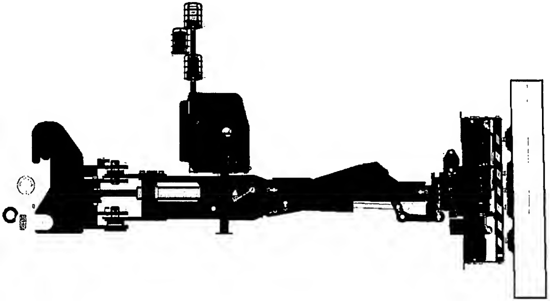

Figure 15.
Panel Shift.

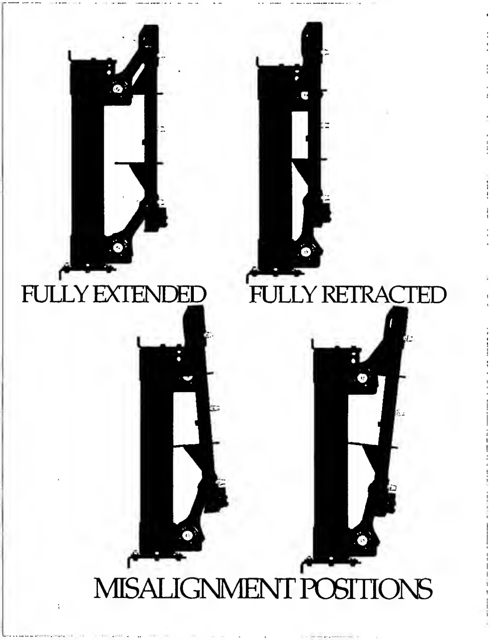

Figure 16.

Soft touch.